

CHAPTER 6

STORM WATER MANAGEMENT ORDINANCE

SECTION

- 18-601. Purpose.
- 18-602. Method.
- 18-603. Technical guidelines.
- 18-604. Submittal requirements.
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18-601. Purpose. To provide a site specific approach to storm water management considering the effects of proposed land development and the defined uses of the down stream property. The approaches utilized to control runoff will be examined on a case-by-case basis with consideration for public safety and welfare. The designs utilized will be selected with consideration for protection of property and quality of runoff to promote the overall good of the community both now and in the future. In all cases structures will have their finished floors located a minimum of one foot above the 100-year flood elevation as defined by the Federal Emergency Management Administration (FEMA). (as added by Ord. #998, Oct. 2005)

18-602. Method. The accepted method of quantifying changes in runoff has been selected to provide a simple yet effective means of estimating the impact of development on a site. The excess runoff created by the proposed development will be compared to the predevelopment runoff by means of the following calculations. Should disturbed areas in excess of one hundred (100) acres be encountered the method of quantifying runoff will be subject to review and approval by the city.

(1) **Rational method.** The method utilizes a worst-case condition at the point of discharge during a design storm of fixed intensity. The formula for quantifying runoff utilizing the rational formula is given as:

$Q = CIA$ where:

Q = quantity of runoff in cubic feet per second.

C = coefficient of runoff dimensionless.

I = rainfall intensity in inches per hour for a given storm event

A = size of the disturbed area in acres.

(a) Runoff coefficient. The runoff coefficient will vary depending on the slope and surface materials for the site. A weighted coefficient can be obtained for predevelopment and post development conditions by selecting values from Table 1 and averaging them according to the size of contribution in the disturbed area.

(b) **Rainfall intensity.** The rainfall intensity is derived by calculating the time of concentration. Time of concentration is the time it takes runoff water to reach the downstream point of discharge in the disturbed area from the farthest point upstream in the disturbed area. The method for calculating this time in minutes is given by Figure 1¹. In no case will time of concentration be less than five (5) minutes. Once a time of concentration has been determined the rainfall intensity can be selected from the chosen storm event curve. Rainfall intensity curves are shown in Figure 2.

(c) **Area.** This is the disturbed area in acres. It will be the same value for both the predevelopment and post development conditions. (as added by Ord. #998, Oct. 2005)

18-603. Technical guidelines. (1) **Drainage system.** The city consists of four main drainage basins that have different degrees of runoff sensitivity depending on the current or proposed land use. The design storm interval for runoff in each basin is defined as follows for purposes of runoff calculations:

Drainage basin 1	10-year storm event
Drainage basin 2	10-year storm event
Drainage basin 3	10-year storm event
Drainage basin 4	25-year storm event

The definition of these drainage basins is shown in Figure 3. The drainage system within a drainage basin is made up of major and minor components defined as follows:

(a) **Major drainage components.** Drainage components with fifty (50) cubic feet per second or greater capacity are considered major and will be designed to pass a 100-year storm event. Development is encouraged to utilize natural drainage as major components wherever possible to prevent the disturbance of existing runoff patterns.

(b) **Minor drainage components.** Minor drainage components are those with a capacity of less than fifty (50) cubic feet per second. These components will be designed to pass a 10-year storm including an overflow design in the event of failure to be diverted to the major drainage system with no damage to property.

(2) **Design storm.** All storm events utilized for design are based on the National Weather Service records for Nashville, Tennessee for a 24-hour rain event (see Figure 2). The design frequency interval utilized will vary depending on the function and location of the drainage component as defined elsewhere in this ordinance.

(3) **Retention/detention ponds.** The use of drainage ponds is encouraged where excessive runoffs from newly developed property threaten the

¹Figures are included at the end of this chapter.

capacity of downstream drainage structures Ponds are designed to delay runoff until sufficient time has elapsed to provide the needed capacity to pass the design storm downstream. Utilization of the retention/detention pond as a storm water control feature is subject to the following rules and regulations.

(a) Residential, commercial or industrial site developers are responsible for the overall development of site detention/retention. Detention/retention improvements must be completed or the developer must post a performance bond or a letter of credit approved by the Lawrenceburg Regional Planning Commission before the developer can transfer ownership

(b) Sites with a developed increase of less than ten (10) percent, not exceeding ten (10) cubic feet per second total runoff are not required to have detention/detention ponds as a storm water control feature.

(c) Sites with direct discharge to a USGS blueline stream are not required to have detention/retention ponds as a storm water control feature.

(d) Detention/retention ponds will have a warranty period of one (1) year from date of completion and successful operation.

(e) Detention/retention outlet structures will be designed to provide water polishing in cases where potential pollutants may be discharged.

(f) Detention/retention ponds will be provided with spillway structures sized to pass the 100-year storm event.

(g) All detention/retention ponds will have an outlet structure that is designed to accommodate downstream flow without increased erosion.

(h) If the drainage way downstream of the point of discharge a distance of one tenth of the longest reach of the developed property is shown to have a capacity for the increased runoff then the site is not required to have detention/retention pond as a storm water control feature.

(i) Modifications to detention/retention ponds will require design calculations by a design professional to verify proper performance under this ordinance and approval by the Lawrenceburg Regional Planning Commission.

(4) Offsite improvements. Existing offsite drainage system improvements may be utilized to accommodate increases in runoff. These improvements are subject to the written approval of the affected property owner and the city.

(5) Exemptions. The following sites are exempt from the conditions of this ordinance:

- (a) Sites with less than one half (1/2) acre of disturbed area.
- (b) Single lot residential sites.

(6) Voluntary drainage improvement. Sites that voluntarily provide additional capacity for storm water runoff improvements within the corporate limits may be eligible for monetary relief. All relief is subject to a recommendation by the Lawrenceburg Regional Planning Commission to the Lawrenceburg Board of Mayor and Commissioners for approval on a case-by-case basis.

(7) Maintenance. Drainage ways and structures, including detention/retention ponds, will be contained within permanent easements for maintenance access. The property owner will have the responsibility of maintaining all drainage system components contained within the site. For residential sites within the corporate limits, the property owner has the option of deeding drainage easements to the city after one year of successful operation. Transfer of ownership will relieve the property owner of all responsibilities pertaining to the drainage system including maintenance.

(8) Drainage structures under public roads. Culverts are to be sized to pass the specified storm without overtopping the roadway. The design storm event will be as follows for all minor drainage components.

- (a) Minor Residential Streets - 10-year storm;
- (b) Collector Streets - 25-year storm;
- (c) Arterial Streets - 50-year storm.

A drainage easement will be required to accommodate backwater created during the 100-year storm in the above listed conditions.

(9) Open channel drainage structures. (a) Ditches lined with grass are to have a maximum side slope of 3: 1 to allow proper maintenance.

(b) Ditches will be lined according to the velocity of the water conveyed as follows:

Grass 0-4 fps;

Riprap 4-8 fps;

Concrete >8 fps. (as added by Ord. #998, Oct. 2005)

18-604. Submittal requirements. (1) Other Sources. All information requested by the city subdivision regulations.

(2) Hydrologic and hydraulic calculations. All calculations shall be submitted by a state approved design professional and organized in such a manner that each submittal shall contain:

(a) A drainage map with contours clearly outlining all pertinent drainage areas.

(b) The acreage of each drainage area

(c) Pre-development and post-development runoff coefficients (show calculations).

(d) Pre-development and post-development time of concentrations (show calculations) corresponding rainfall intensities or amounts.

(e) Predevelopment and post development peak flows.

- (f) Detention calculations with emergency spillway calculations.
- (g) Hydraulic calculations (submit copies of drainage charts showing results if nomographs are used) for each proposed drainage structure and/or open channel and for each immediate downstream structure.
- (h) Invert and over-topping elevations on all previously mentioned culverts.
- (i) Lowest Floor Elevation (LFE) for each building adjacent to a major drainage system (submit open channel flow calculations justifying LFE's).
- (j) Lowest floor elevation for each building adjacent to a designated floodplain area (submit flood map and flood profile map with development delineated). (as added by Ord. #998, Oct. 2005)

18-605. Validity. All ordinances or parts of ordinances in conflict herewith are hereby repealed. The invalidation of any section, clause, sentence, or provision of this ordinance shall not affect the validity of any other part of this ordinance that can be given effect without such invalid part or parts. (as added by Ord. #998, Oct. 2005)

18-606. Ordinance in force. This ordinance shall take effect immediately after its passage on second reading, the public welfare requiring it. At such time as current planned improvements are made to the major drainage components in basin 4 the requirement for 25-year storm interval will be revised to 10-year storm interval. (as added by Ord. #998, Oct. 2005)

APPENDIX A

DEFINITIONS

The following definitions shall apply in the interpretation and enforcement of the provisions of these regulations in addition to those terms defined in the Ordinance, unless specifically stated otherwise:

Closed Conduit - Pipes, tiles, boxes, arches or tunnels used to carry storm water runoff.

Culverts - Pipes, tiles, boxes, arches or tunnels used to carry storm water runoff underground to improve safety or comfort. Culverts are constructed from concrete or corrugated metals.

Detention - A water impoundment that temporarily contains storm water runoff to reduce the peak flow and pollutants entering the receiving waters.

Drainage - The action or method of draining storm water runoff.

Drainage area - A part of the surface of the earth that is occupied by and provides surface water runoff into a drainage System.

Drainage basin - A drainage area or a group of drainage areas that consist of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded surface water.

Drainage network - A combination of culverts and/or open channels used in conjunction to conduct flowing water (usually storm water runoff) to an adequate discharge point.

Drainage structure - Consists of a variety of components in the drainage system ranging from culverts, catch basins and manholes to emergency spillways.

Drainage Way - A natural or artificial watercourse, with definite or indefinite boundaries to confine or conduct continuously or periodically flowing water.

Emergency spillway - Usually a concrete structure used to safely discharge temporarily stored storm water runoff over a berm or dam into a receiving channel.

Invert elevation - The elevation of the bottom of a culvert at the opening, "Invert In" is the upstream invert elevation, and "Invert Out" is the downstream invert elevation of a culvert.

Lowest floor elevation - The lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access, or storage and in an area other than the basement area, is not considered a building's lowest floor.

Nomograph - A chart used to graphically determine engineering design values. Nomographs are commonly used to size culverts, predict time-of-concentrations, and to estimate peak flows.

One hundred-year design flow - The peak flow of storm water runoff that is produced by the precipitation of a storm that has a one percent (1%) probability of occurring any given year.

One hundred-year flood elevation - For the City of Lawrenceburg, this is the highest floodwater elevation as a result of the one hundred-year design flow at each point along the major storm drainage system.

Open channel - A storm water runoff conduit flowing by the forces of gravity. Open channels consist of rivers, creeks, swales or depressions, roadway gutters and possibly culverts.

Over-topping elevation - The elevation where storm water runoff first crosses a road, berm, dam or emergency spillway.

Peak Flows - The highest volume of storm water runoff over a constant time interval to pass through a known location, usually measured in cubic feet per second (cfs).

Point of discharge - The downstream location at which runoff leaves the property Post Development The site as it exists after full development has occurred.

Pre-development - The site as it exists before any development or additional development has taken place.

Rainfall intensities - The amount of rainfall over a specific time period, usually measured in inches per hour (in./hr.).

Retention - A Water impoundment that permanently contains water, but also temporarily stores storm water runoff to reduce the peak flow and pollutants entering the receiving waters.

Runoff - The actual amount of precipitation that does not infiltrate into the ground or get stored naturally in depressions, and eventually reaches receiving waters.

Runoff coefficients - A variable used in hydrology equations to predict the amount of storm water runoff produced from a given amount of precipitation.

Site - All contiguous land and bodies of water in one ownership, graded or proposed for grading or development as a unit, although not necessarily at One time.

Storm frequency - A probability of a certain amount of precipitation to occur from a storm in any given year. (i.e. 10-year storm frequency defines a storm of having a 1/10 probability of occurring any given year; 100-year storm frequency defines a storm of having a 1/100 probability of occurring any given year .

Storm water - A measurable amount of rainfall.

Storm water runoff - The volume of rainfall which is not absorbed or stored over a specific time interval, usually measured in cubic feet per second (cfs).

Ten-year design flow - The peak flow of storm water runoff that is produced by the precipitation of a storm that has a ten percent (10%) probability of occurring any given year.

Time of concentration - Is estimated from the drainage areas characteristics and description of the drainage way. It is the time required for runoff to travel from the most remote point in the drainage area to the point in the drainage basin that is being analyzed. The most remote point is usually the furthest point in the drainage area from the point being analyzed.

Water impoundments - A permanent or temporary body of water with definite limits such as lakes, ponds, detention or retention facilities.

Watershed - A drainage area or a group of drainage areas that consist of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded surface water.

APPENDIX B

References:

Hydrology - Research, Development and technology, U.S. Department of Transportation, Federal Highway Administration, October 1984.

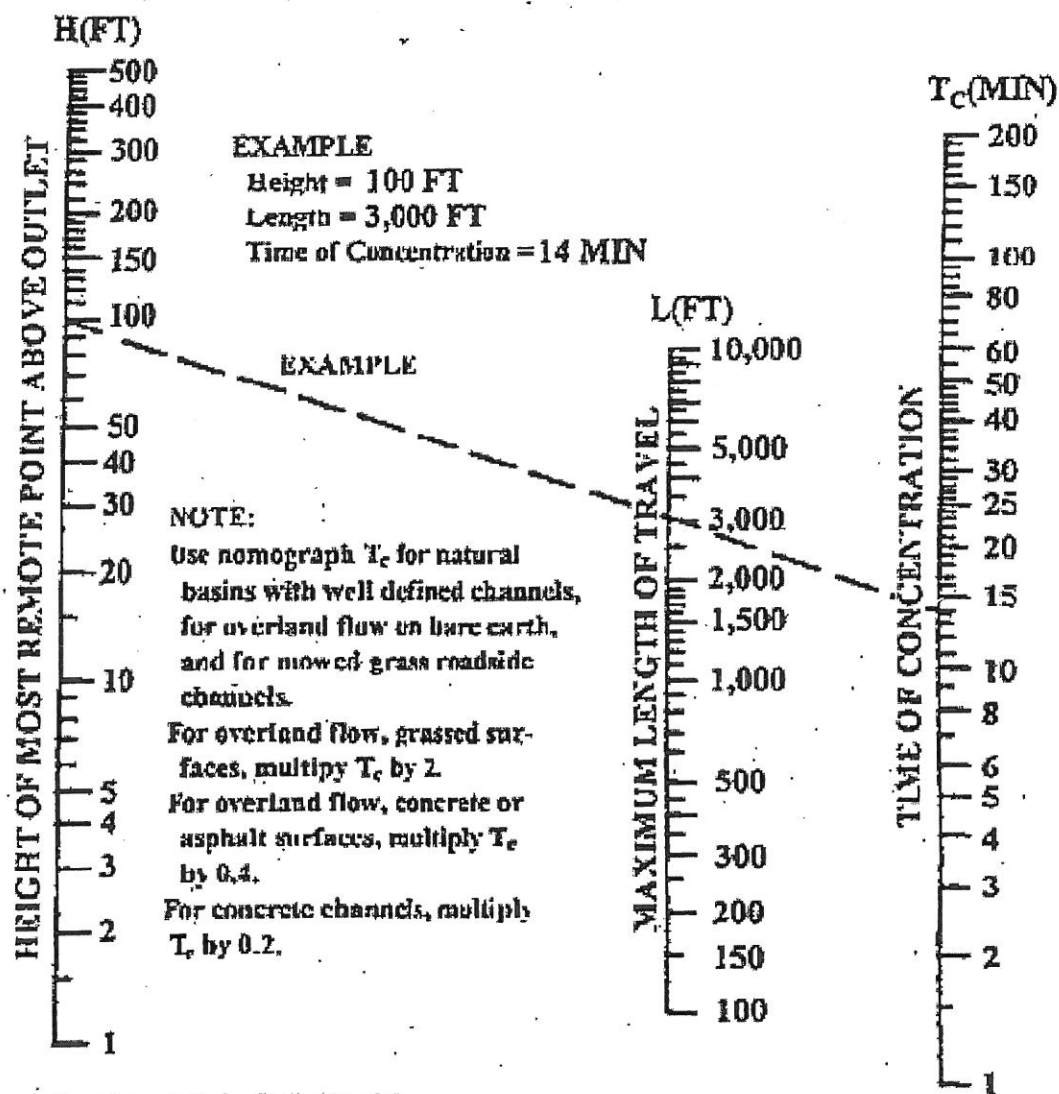
Brentwood zoning ordinance - Developed by the City of Brentwood, Tennessee and its consultants.

Storm water management manual Volume 1, Regulations, Metropolitan Government of Nashville and Davidson County and its consultants, July 1988.

Storm water management - Volume 2, Procedures, Metropolitan Government of Nashville and Davidson County and its consultants, July 1988.

Figure 1

TIME OF CONCENTRATION (T_c) for small drainage areas



Based on study by P. Z. Kirpich.

Civil Engineering, Vol. 10, No. 6, June 1940, p. 362

Figure 2

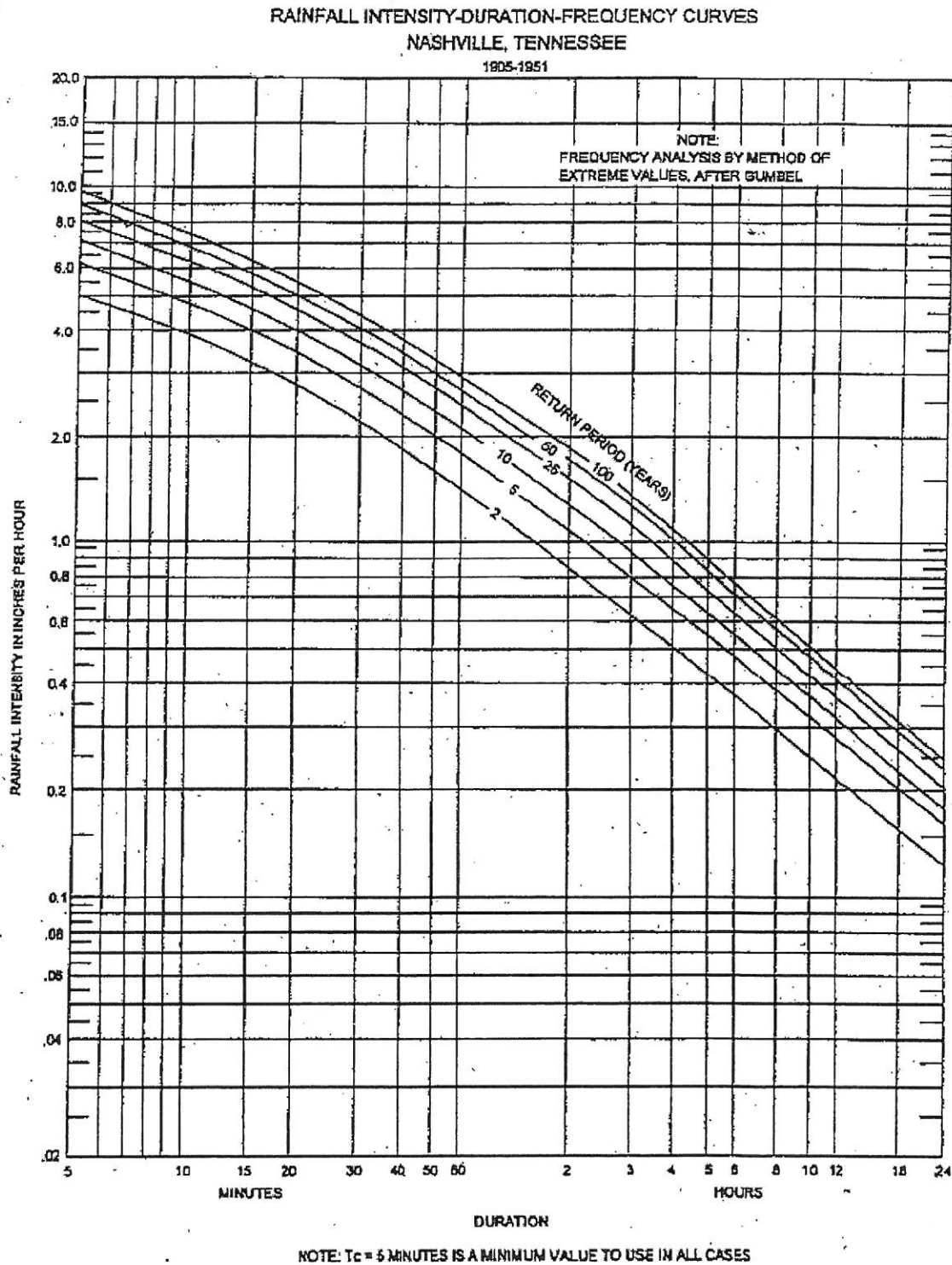


Figure 3



Table 1

* RUNOFF COEFFICIENTS² FOR A DESIGN STORM RETURN
PERIOD OF 10 YEARS OR LESS

Slope	Typical Land Use	Sandy Soils		Clay Soils	
		Min.	Max.	Min.	Max.
Flat	Woodlands	0.10	0.15	0.15	0.20
(0-2%)	Pasture, grass, and farmland ^{1a}	0.15	0.20	0.20	0.25
	Rooftops and pavement	0.95	0.95	0.95	0.95
	Pervious pavements	0.75	0.95	0.90	0.95
" Rolling	Woodlands	0.15	0.20	0.20	0.25
(2-7%)	Pasture, grass, and farmland	0.20	0.25	0.25	0.30
	Rooftops and pavement	0.95	0.95	0.95	0.95
	Pervious pavements ²	0.80	0.95	0.90	0.95
Steep	Woodlands	0.20	0.25	0.25	0.30
(7%+)	Pasture, grass, and farmland ^{1a}	0.25	0.35	0.30	0.40
	Rooftops and pavement	0.95	0.95	0.95	0.95
	Pervious pavements ²	0.85	0.95	0.90	0.95

^{1a}Weighted coefficient based on percentage of impervious surfaces and green areas must be selected for each site.

²Coefficients assume good ground cover and conservation treatment.

³Depends on depth and degree of permeability of underlying strata.

Specific Zoning Classification	Runoff Coefficients
Residential	
R-1	0.25-0.35
R-2	0.40-0.50
R-3	0.45-0.55
R-4	0.65-0.75
Commercial	
C-1	0.85-0.95
C-2	0.70-0.80
C-3, C-4, C-5	0.65-0.75
Industrial	
I-1	0.80-0.90
I-2	0.75-0.85

Note: For specific zoning classifications, the lowest range of runoff coefficients should be used for flat areas (areas where the majority of the grades and slopes are 2 percent and less). The average range of runoff coefficients should be used for intermediate areas (areas where the majority of the grades and slopes are from 2 percent to 7 percent). The highest range of runoff coefficients should be used for steep areas (areas where the majority of the grades and slopes are greater than 7 percent).

Reference: Coefficient values adapted from DeKalb County (1976).
Zoning classification data derived from Zoning Regulations of the City of Lawrenceburg, Tennessee (1993).